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ABSTRACT

This paper formulates a comprehensive model of resource allocation in a local public school district. The theoretical framework specified could be applied equally well to any number of local public social service agencies. Section 1 develops the theoretical model describing the process of resource allocation. This involves the determination of the demand for school inputs, the salaries of school personnel, and the level of local educational expenditures. Section 2 is a presentation of the empirical results of estimating these sets of equations on a sample of California public school districts. Some of the issues investigated in the empirical analysis include the price and income elasticity of the demand for teachers, the effects of tenure on the demand for certain teacher quality characteristics, the determinants of the equilibrium salaries of teachers and public school administrators, the differences between the effects of changes in community income and federal and state grants-in-aid on local school spending, and the compensatory effects of grants-in-aid on school spending, the demand for school inputs, and salaries of school personnel in high and low income school districts. (Author)

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A MODEL OF RESOURCE ALLOCATION IN PUBLIC SCHOOL DISTRICTS: A THEORETICAL AND EMPIRICAL ANALYSIS

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In recent years, there has been a growth of interest among economists in the allocation of resources in the public sector. This interest has taken the form of research on the effectiveness of public agencies, the determination of public expenditures at the federal, state and local levels on various public services, and models of public sector employment and wage determination. Perhaps one of the largest areas of research has focussed on public education where contributions to the literature have been primarily in the form of empirical investigations of production and expenditure relationships and theoretical discussions of the impact of the nature of educational institutions on the efficiency with which educational services are produced.

This paper formulates a comprehensive model of resource allocation in a local public school district. The theoretical framework specified below could be applied equally well to any number of local public social service agencies. Section I develops the theoretical model describing the process of resource allocation. This involves the determination of the demand for school inputs, the salaries of school personnel, and the level of local educational expenditures. Section II is a presentation of the empirical results of estimating these sets of equations on a sample of California public school districts. Some of the issues investigated in the empirical analysis include: (1) the price and income elasticity of the demand for teachers; (2) the effects of tenure on the demand for certain teacher quality characteristics; (3) the determinants of the

equilibrium salaries of teachers and public school administrators; (4) the differences between the effects of changes in community income and federal and state grants-in-aid on local school spending; (5) and the compensatory effects of grants-in-aid on school spending, the demand for school inputs and salaries of school personnel in high and low income school districts.

I. The Theoretical Framework

The focus of this analysis is the behavior of the individual public school district. There are primarily two basic decisions with which school district decision-makers must concern themselves.[1]/

(1) the allocation of community resources between public education and all other goods and services,

and (2) the allocation of educational resources among the various school inputs.

A complete specification of a model of district behavior requires the incorporation of both of these decisions which, in fact, occur simultaneously. In order to identify the underlying structural relations, each of these allocation decisions will be considered separately within a two stage process. Once the structural relations have been specified, one can more easily visualize the simultaneity of the two decisions.

Initially, a model of the allocation of educational resources among school inputs is presented under the assumption that school decision-makers operate with a fixed, exogenously determined budget. The assumption of the fixed budget is subsequently relaxed in order to examine the way district decision-makers determine the level of community resources to be devoted to educational services.

Allocation of Educational Resources

The optimal employment levels of school inputs are determined as the solution

to a constrained maximization problem for school decision-makers. The objective function is assumed to reflect the decision-makers' perceptions of the capability of the school district to provide each pupil, on the average, with a certain quantity of a relevant set of abilities, skills and characteristics. In effect, this objective function, which will be referred to as the perceived quality function, specifies the level of education services that can be produced by a given combination of the set of school inputs. Given the determinants of the school input prices, district decision-makers are assumed to maximize the perceived quality of educational services subject to a budget constraint and a tenure constraint, which imposes limits on the choice of the quality characteristics of school personnel.

The perceived quality function (Q) is formally assumed to depend upon the quantity per pupil (T) and the average quality (q) of school personnel (e.g., teachers, teachers' aides, and administrators), the rates of turnover (θ) among these school personnel, the quantity of all other school inputs per pupil (K), and a vector of exogenous district characteristics and nonschool inputs (Z_Q) which affect the perception of educational quality by school decision-makers.[2] This perceived quality function is written.

$$Q = F(T, q, \theta, K; Z_Q) \qquad (1)$$

where the marginal perceived quality (or marginal product), denoted MQ, of each of the inputs is assumed to be positive, except for MQ_θ which is negative; and the perceived quality function is subject to diminishing returns to each of the inputs except for θ to which perceived quality is subject to increasing negative returns, after some point.

The quantity of school personnel per pupil (T) is intended to reflect, for example, the amount of individual attention which teachers are capable of devoting

to the learning experience of each child.

The quality (q) of school personnel refers to the set of characteristics which are perceived by school district decision-makers to affect the quality of instructional services. Whether or not these characteristics are correlated with actual quality (however it may be defined) is not of relevance to the model. It is only necessary for such personnel characteristics to be perceived as contributing to educational quality. Three types of characteristics are included in q: years of experience (q_x), educational preparation (q_e, measured empirically by college credit hours), and a set of other personal characteristics (q_0) which reflect the ability of school personnel.[3] Personnel experience and educational preparation are generally explicitly recognized in school district salary schedules.

The turnover rates (θ) are included in the perceived quality function to reflect the stability of the staff of the school district. It is assumed that a high level of turnover either among teachers or administrators may be very disruptive to the educational program (e.g., the coordination of activities between teachers and/or administrators) and therefore, tend to reduce the level of quality of educational services.[4] Furthermore, turnover is highly visible to the school board, and a high rate of turnover may induce the board members to question administrators as to the reasons for the lack of staff stability. High turnover may be regarded as some indication of the deficiency of the superintendent's administrative abilities.

The vector Z_Q includes the number and characteristics of pupils in the school district. It is hypothesized that school decision-makers in districts of differing sizes (as measured by the number of pupils, S) will perceive educational quality differently.[5] Furthermore, since children who are raised in relatively different cultural environments may require different combinations of school

inputs, the racial and ethnic composition of the pupils (as measured by the proportion of Black students, SB, and the proportion of students with Spanish surnames, SS) are likely to be relevant components (or at least perceived to be so by school decision-makers) of the learning environment.[6] Therefore, the vector $Z_Q = (S, SB, SS)$.

The budget constraint simply requires that the school district spend all of the revenue it receives from the various sources (i.e., federal, state, and local).[7] The constraint may be written as

$$R = W(q, \theta, T; Z_W) \cdot T + C \cdot \theta \cdot T + P \cdot K \qquad (2)$$

where R is the district's total real budget per pupil (assumed to be given exogenously at this state of the analysis), $W(\cdot)$ is the vector of average annual salaries of school personnel, C is the vector of real unit turnover costs of school personnel, and P is the vector of real unit prices of the other school inputs (K).

The prices C and P are assumed to be exogenously determined and for the purposes of the empirical analysis they are assumed to be constant across districts since there are no readily available data on these prices and it is likely that their exclusion will have little effect on the results.

The average annual salaries of school personnel are endogenous to district decision-making and are assumed to be functions of personnel quality (q), the respective rates of turnover (θ), the quantity of school personnel per pupil (T), and a set of exogenous factors (Z_W) which reflect the relative attractiveness of employment opportunities. Presumably, there is a positive relationship between the salaries and quality of school personnel (i.e., $\partial W/\partial q > 0$). Salaries are assumed to be negatively related to turnover (i.e., $\partial W/\partial \theta < 0$) reflecting the notion that districts desiring a relatively stable staff will be required to make employment relatively more attractive than alternative opportunities.[8]

The inclusion of the staff-pupil ratio (T) in the salary function is intended to reflect the impact of endogenously determine working conditions on personnel salaries. For example, districts with smaller average class sizes (i.e., larger teacher-pupil ratios) and/or larger numbers of teachers' aides per pupil, ceteris paribus, are likely to be regarded by teachers as more attractive places in which to teach. Therefore, one would expect teachers to sacrifice some wages to work in these districts (i.e., $\partial W/\partial T < 0$).

The exogenous factors (Z_W) which affect personnel salaries include district size, the racial and ethnic characteristics of pupils, and the opportunity costs facing particular categories of school personnel in the local labor market. Due to the nonpecuniary disadvantages associated with working in larger school districts or with providing educational services to minority pupils, one would expect that, ceteris paribus, larger districts or districts with larger proportions of minority pupils will have to pay relatively higher wages to attract teachers (i.e., $\partial W/\partial S, \partial W/\partial SB, \partial W/\partial SS > 0$).[9]

For the purpose of specifying the opportunity costs, school personnel are broken down into three categories; certified instructional personnel (e.g., teachers), instructional aides, and school administrators. The opportunity costs facing certified personnel, aides, and administrators will be represented empirically by the average annual wages of registered nurses (WT), nurses aides (WI), and public administrators (WA) -- excluding school administrators-- respectively, within the SMSA in which the district is located.[10]

An additional constraint on the district's optimization problem involves the limitations on the choice of personnel quality which are imposed by the tenure laws. In effect the provisions of the tenure laws, while allowing districts to choose the number of teachers to be employed, constrain the choice of which teachers (and presumably the combination of quality characteristics q they possess) will

be employed by specifying seniority as the basis for the order of dismissal of school personnel--those with the least seniority being dismissed first in response to a decline in enrollment or the elimination of educational programs.[11]

In order to formulate the tenure constraint, school personnel are divided into two groups: those who are effectively tenured in the district and those who are hired new to the district for the upcoming school year.[12] Letting $q^{(t)}$ and $q^{(h)}$ represent the average quality of effectively tenured teachers and newly hired school personnel, respectively, the average quality of the entire staff may be written.

$$q = (1 - \theta) \cdot q^{(t)} + \theta \cdot q^{(h)} \qquad (3)$$

where θ (the variable reflecting turnover) is the fraction of newly hired personnel.[13] Since $q^{(t)}$ is fixed according to the tenure laws, the district's decision variables in equation (3) are obviously $q^{(h)}$ and θ.[14] Since the district can adjust personnel quality only at the margin through $q^{(h)}$, the lower turnover rate (θ) the less significant will be the effects of changes in $q^{(h)}$ and q (i.e., the more difficult it is for the district to adjust the level of staff quality).

Equation (3) implies a set of lower and upper bound constraints imposed on q corresponding to the points where $q^{(h)}$ is chosen at its minimum value (i.e., $q^{(h)} = q_{min} = 0$) and maximum value (i.e., $q^{(h)} = q_{max}$), respectively.[15] However, one generally observes that newly hired teachers usually are relatively inexperienced and possess the miminum of educational requirements. This suggests that in general the upper bound constraint on average experience and education is nonbinding. Given this one additional piece of information, the constraints on staff quality may now be reduced to a set of lower bound constraints on q (which, in effect, amounts to a set of nonnegativity constraints on $q^{(h)}$, the decision variable) with the upper bound constraint remaining operative on q_0,

the ability characteristics of school personnel. The quality constraints can now be written as

$$q_0^{(h)} \leq q_{0_{max}} \tag{4a}$$

and

$$q^{(h)} \geq 0. \tag{4b}$$

One can now determine the optimal employment levels of the school inputs as the solution to the problem involving the maximization of perceived educational quality (1) subject to the budget constraint (2) and the tenure constraints in (4). If the tenure constraints are nonbinding on the solution to this optimization problem, then the usual equilibrium conditions,

$$\frac{MQ_T}{MC_T} = \frac{MQ_q}{MC_q} = \frac{MQ_\theta}{MC_\theta} = \frac{MQ_K}{MC_K} \tag{5}$$

are obtained, where the MC's denote the respective marginal costs of the inputs. In this case, school decision-makers are able to immediately adjust school inputs to their optimal levels.

The solution to these equilibrium conditions (5) combined with the budget constraint leads to a set of equations for the demand for school inputs, denoted $D = (T, q, \theta, K)$, as functions of all the exogenous variables, denoted $Z = (Z_W, C, P, Z_Q)$ or substituting for Z_W and Z_Q one obtains $Z = (WT, WI, WA, S, SB, SS, C, P)$. The optimal input demands D* may then be written in vector notation as

$$D^* = D(Z, R). \tag{6}$$

The optimal values of the personnel salaries, $W(q, \theta, T; Z_W)$, are also endogenously determined due to their dependence upon personnel quality characteristics, turnover, and the endogenous working conditions. Substituting the relevant components of D* into W, one obtains

$$W^* = H(Z, R).^{16/} \tag{7}$$

The relationships between personnel salaries and the elements of Z may be decomposed into two parts: (1) the elements of Z_W have direct effects, $\partial W/\partial Z_W$, due to their appearance in the structural equation $W(q, \theta, T; Z_W)$; and (2) changes in the elements of Z have an indirect effect on W* through their effects on the demand for school inputs which in turn affect the determination of personnel salaries, i.e., $(\partial W/\partial D) \cdot (\partial D/\partial Z)$. Furthermore, the only reason one could observe a relationship between the district budget R and the equilibrium personnel salaries W* is if these salaries are endogenously determined, i.e., if W depends upon any of the elements of D. This issue is discussed further along with the empirical results.

If the tenure constraints (4) are binding on the district's optimization problem, district officials discover that immediate adjustment of personnel quality is not possible. In effect, the district's turnover rate is too low to allow decision-makers to adjust completely personnel quality to its optimal value. School officials must strike a balance between the relative marginal benefits and costs of raising turnover rates as a means of increasing their ability to adjust personnel quality to preferred levels. On the one hand, raising turnover reduces perceived quality of educational services (since $MQ_\theta < 0$) and reduces the compensation of inputs (since $\partial W/\partial \theta < 0$). At the same time, a higher turnover rate increases the size of the margin of new personnel through which personnel quality may be adjusted to its desired (optimal) level. Such an adjustment would involve an improvement in personnel quality if the upper bound constraint on q_0 had been binding and a reduction in personnel quality in the case of binding lower bound constraints on any one or all of the elements of q.

There are two alternative methods of determining whether or not districts are operating on the constraints for personnel quality. Assuming the data were

available, the simplest way is to observe the average quality characteristics (at least of experience and educational preparation) of newly hired teachers in a district. If one finds that a district chooses the minimum quality levels for its new teachers, it suggests that the district may be operating on the lower bound constraint.[17] A second method is to obtain empirical estimates of the set of demand equations for teacher quality. If it is determined that the demand for any one of these quality characteristics (q_x, q_e, q_0) is unrelated to the set of independent variables (Z, R) specified in (6), it might be suspected that many of the districts in the sample were operating on their lower (upper) bound constraints for q_x or q_e (q_0). This issue is addressed further in the empirical analysis below.

Another interesting hypothesis regarding the choice of administrative quality may be drawn from the equilibrium conditions. Specifically, one might suggest that the marginal contribution to district quality of a particular administrator is likely to be greater in larger districts since his actions and decisions generally have an effect on the allocation of a greater quantity of educational resources which ultimately affects the quality of educational services to a larger number of students. Stated more formally, the marginal product of administrative quality is positively related to district size (i.e., $\partial MQ_{q_a}/\partial S > 0$, where q_a represents administrative quality).[18] If this is in fact the case, then one would expect to find that larger school districts tend to select higher quality administrators and, therefore, to pay higher salaries to administrative personnel. These higher salaries of administrators in larger school districts result from the fact that they are not only better quality administrators but also that their decisions tend to affect the absolute contributions to educational quality of more inputs for a greater number of pupils.

Allocation of Community Resources

Up to this point in the analysis, the school district's budget (R) has been

assumed to be determined exogenously. In fact, district budgets are determined endogenously by school decision-makers through their control over local school property tax rates.

School decision-makers are assumed to determine their budgets as the solution to a constrained maximization problem.[19] The objective function is a utility function (U) which depicts the decision-makers' perception of the willingness of the school board (or local community) to bear increased school property tax burdens per household (B), a negative good, to obtain greater (perceived) quality of education (Q), a positive good.[20] The utility function is assumed to be subject to diminishing marginal utility of educational quality and increasing marginal disutility of tax burden. Tax burden per household is assumed to increase with real school property taxes per household π (i.e., $\partial B/\partial \pi > 0$), decrease with real personal disposable income per household Y (i.e., $\partial B/\partial Y < 0$), and increase with the proportion of residential to total assessed value of property ν (i.e., $\partial B/\partial \nu > 0$). The positive relation between the proportion of residential property and tax burden reflects the hypothesis that school decision-makers tend to weight more heavily the preferences of residential relative to business property owners since the residents are the voting constituency of the local community.[21] It is further assumed that the marginal tax burden per household is higher in communities with a large proportion of residential property (i.e., $\partial^2 B/\partial \nu \partial \pi > 0$), since households will bear a relatively larger portion of the tax burden) and lower in high income communities (i.e., $\partial^2 B/\partial Y \partial \pi < 0$).

Given the set of demand equations (6), one can substitute back into the perceived quality function (1) to obtain the optimal level of perceived quality (Q*) as an indirect function of the exogenous variables (Z) and the budget (R) of the district. This indirect perceived quality function, $Q^* = Q(Z, R)$, is

convex in those elements of Z which are positively related to the marginal costs (MC's) of the school inputs (i.e., $\partial Q/\partial Z < 0$, and $\partial^2 Q/\partial Z^2 > 0$) and concave in R (i.e., $\partial Q/\partial R > 0$ and $\partial^2 Q/\partial R^2 < 0$).[22] Given this indirect perceived quality function, district decision-makers are able to trace out the relationship between the resources devoted to educational services (R) and the quality of those services produced (Q), ceteris paribus.

Combining this formulation of the perceived quality function with the information about the tax burden function set out above, the utility function for school decision-makers may be formally expressed as

$$U = U\left[Q(Z, R), B(\overline{TT}, Y, \gamma); X_U\right], \tag{8}$$

where X_U represents the exogenous characteristics of the community which may influence the rate of trade-off between Q and B.[23]

District decision-makers are assumed to maximize their utility function (8) subject to the constraint that total educational expenditure per pupil (R) be equal to total local school taxes per pupil ($\overline{TT} \cdot (N/S)$, where N is the number of households in the local community) plus total state and federal aid per pupil (R_g) provided to the district.[24] Formally, this constraint may be written.

$$R = \overline{TT}(N/S) + R_g . \tag{9}$$

The solution to this constrained maximization problem leads to the result that the marginal rate of substitution of educational quality for lower tax burdens per household be equal to the real marginal cost per household of providing educational services.[25] The solution of the equilibrium conditions generates an expenditure function

$$R = R(Z, R_g, S/N, Y, \gamma, X_U). \tag{10}$$

With the additional assumption that the utility function (8) is separable (i.e., $\partial^2 U/\partial B \partial Q = 0$), one can determine the direction of the affects of many of the exogenous variables on the level of educational expenditure per pupil.[26] The properties of the expenditure function imply the following relationships: educational expenditures will increase in response to increased government aid ($\partial R/\partial R_g > 0$), but to some extent these funds will be used to reduce local property taxes ($\partial R/\partial R_g < 1$); the greater the relative number of children per family in the community, the greater would be the marginal tax burden per household to provide a given quantity of resources for education and, therefore, the lower will be the expenditure per pupil for education ($\partial R/\partial(S/N) < 0$); high income districts will tend to devote relatively more resources per pupil to education ($\partial R/\partial Y > 0$); the greater the relative proportion of residential property (and, therefore, the greater the extent to which households, as opposed to business, must support educational services,), the lower the expenditures on education ($\partial R/\partial V < 0$).

For the purposes of the empirical analysis, the vector X_U is assumed to include the pupil-household ratio (S/N) along with some proxies for the socio-economic status of the community. Presumably, the greater number of families in the community who have school age children, the greater will be the perceived willingness of the community to spend for education ($\partial R/\partial(S/N) > 0$). This hypothesis runs counter to the previous analysis of the effects of the pupil-household ratio on the tax burden. Therefore, the net effect of S/N on R will depend on the relative strengths of these two opposing forces. Furthermore, some evidence suggests that higher socioeconomic status communities tend to have relatively stronger preferences for educational spending.[27] For this purpose, community income (Y) and the racial and ethnic characteristics of the pupils

(i.e., SB and SS) will be used as proxies for socioeconomics status.

The effects of changes in the components Z on R are ambiguous. However, one can state that if school spending increases (decreases) with those elements of Z which tend to raise input prices, then the demand for educational quality tends to be relatively inelastic (elastic).

II. An Empirical Application

The Data

As specified in Section I, the model of the public school district is composed of a set of behavioral equations for the demand for school inputs (6), the salaries of school personnel (7), and the school expenditures per pupil (10). The empirical analysis will focus attention on a subset of the demand and salary equations. The set of salary equations to be estimated includes the base wage (W_{T0}) and salary increments for additional experience (α_{Tx}) and education (α_{Te}) paid to teachers[28], the salaries of elementary (W_{P_E}) and high school (W_{P_H}) principals, and the salaries of district superintendents (W_S). The demand equations to be estimated are limited to those school inputs which reflect the quantity and quality of teachers' services: the ratio of regular classroom teachers to pupils for elementary (T_E) and high (T_H) schools, the average years of experience for elementary ($q_{T_E x}$) and high school ($q_{T_H x}$) teachers, and the average units (college credit hours) of graduate education acquired by elementary ($q_{T_E e}$) and high school ($q_{T_H e}$) teachers. In conjunction with these salary and input demand equations, a behavioral equation for the district budget per pupil (R) will also be estimated.

Two cross-section samples of individual school districts were selected for the empirical analysis: a sample of 39 elementary districts (which include only

elementary schools, K-8) and a sample of 50 unified districts (which includes both elementary and high schools) located within the six largest SMSA's in California. The necessary data were gathered for the 1970-71 school year.

For the sample of unified districts the vector Z_Q, the set of district characteristics and nonschool inputs which affect school decision-makers' perception of educational quality, contains one additional element: the fraction of elementary school pupils (SE) in the district. This variable is simply intended to reflect the possible impact of the variation in the composition of pupils on the allocation of resources between the levels of instruction.

In Section I the variable ν is defined as the ratio of real residential to total real assessed valuation of property (i.e., $\nu = V_r/V$ where V_r and V denote the real assessed value of residential and total property, respectively). It has been suggested that the income and tax base composition effects on school spending are likely to be confounded unless the relationship between community income and the value of residential property is explicitly incorporated into the model.[29] For this purpose, it has been assumed that, as in the case of any consumer good, the quantity of housing services (as reflected by real residential property values) consumed by the residents of the community will depend (positively) upon real personal disposable income (Y) and upon various environmental characteristics of the community. For simplicity it is assumed that these environmental characteristics are captured by the racial and ethnic composition of the community (measured for empirical purposes by SB and SS) under the hypothesis that communities with relatively high proportions of minorities will have lower real property values. Assuming that the real value of residential property may be approximated by a linear function, one may specify the following expression for the ratio of real residential to total real assessed value of property.[30]

$$\nu = \gamma_0(1/V) + \gamma_1(Y/V) + \gamma_2(SB/V) + \gamma_3(SS/V) \qquad (11)$$

where $\gamma_1 > 0$ and $\gamma_2, \gamma_3 < 0$. This equation may then be substituted for ν in equation (10) to become a determinant of school expenditures.

The Econometic Methodology

Because of the relatively small samples of school districts, it seemed appropriate in most instances to use linear approximations for the relationships between the dependent and independent variables specified in the behavioral equations. However, in some cases variables are entered into the model in a nonlinear form because it (1) improved the predictive power of the equations, (2) increased the precision of the estimates of the average elasticities of the dependent variables with respect to the particular independent variable, and/or (3) conformed to a priori expectations regarding the nature of the relationship. In all of the salary and demand equations, the budget (R) and district size (S) variables appear in a nonlinear form as their inverses (1/R and 1/S, respectively) to allow for a variation in the rate of response of personnel salaries and demand for school inputs to changes in the school budget.[31]/

Furthermore, in carrying out the derivation of the properties of the budget equation (10), one finds that the two varialbes R_g and S/N enter the relationship multiplicatively. In fact, the partial derivative of R with respect to R_g is proportional to S/N while the partial derivative of R with respect to S/N is a linear function of R_g. The empirical relations have been specified in order to reflect these theoretical propositions.

The system of equations which defines the model appears to be recursive in R. That is, each of the salary and demand equations depends upon the per pupil budget (R) which in turn depends upon a set of exogenous variables. However,

since the equilibrium values of the personnel salaries and demands for school inputs are, in fact, determined simultaneously with the size of the district's budget, the budget is likely to be correlated with the disturbance terms in the salary and demand equations. In order to provide for consistent estimates of the parameters of the model, two stage least squares is used to estimate the salary and demand equations. In the empirical application of the model, however, both ordinary least squares and two stage least squares methods were used. Since the two estimation procedures yield substantially the same results (with 2SLS estimates exhibiting somewhat less precision--lower t-statistics--than the OLS estimates), the empirical analysis will focus attention, for the most part, on the 2SLS estimates.

The Empirical Results[32]/

Only a subset of the empirical results are discussed in any detail because of the difficulty of interpreting the net effects of changes in some of the exogenous variables on the allocation of resources. Some of these variables enter the model in a number of places and involve various opposing forces on the equilibrium values of the decision variables of the district.[33]/ For those variables for which the net effects are difficult to evaluate, their inclusion in the equations is assumed to be in the capacity of control variables and no attempt is made to interpret the empirical results. Where the patterns of the net effects are reasonably clear and the variable is regarded as central to the evaluation of the model, the significance and implications of the empirical results are discussed.

The Demand for Teachers. It has often been suggested in the literature that the demand for teachers, and for that matter public employees generally, is likely to be relatively inelastic with respect to budget and price changes.[34]

One of the objectives of this empirical analysis is to test these hypotheses regarding the elasticity of the demand for teachers.

The empirical results, presented in Table 1, indicate that the demand for teachers in generally inelastic with respect to changes in the budget of the school district. The estimates imply that a one percent increase in

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Table 1 about here

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school expenditures will, on the average, lead to between a 0.20 to 0.26 percent increase in the demand for teachers. On the average, such an increase in the demand for teachers is equivalent to a decrease in class size of approximately 1/16th of a pupil. Alternatively stated, in order to induce school decision-makers to decrease elementary (high school) class size by one pupil, one would have to increase school budgets by approximately $150 ($260) per pupil. This implies the existence of a somewhat rigid perceived educational technology with regard to class sizes (i.e., the number of teachers employed per pupil).

The nonlinearity in the budget variable implies that the low budget districts which presumably have larger class sizes are more eager to reduce class sizes in response to increases in their budgets than are high budget districts which already have relatively small class sizes.[35/] In fact, in all cases high budget (defined as one standard deviation above the mean budget) districts require more than three times the budget increase required by the low budget (defined as one standard deviation below the mean budget) districts to induce a reduction in class size of one pupil. Presumably, once a certain level of class size is obtained, district decision-makers apparently are now inclined to direct budget increases toward employment of other types of school inputs.[36/]

The price elasticities of the demand for teachers are reflected by the response of teacher demand to changes in the opportunity costs WT, WI, and WA. Unfortunately, because of the relatively high pair-wise correlations between these opportunity costs over the samples of school districts, the estimates of the elasticities of demand are likely to possess a low level of precision. Hence, these empirical results are to be interpreted with due caution.

In both elementary and unified districts the demand for elementary school teachers is relatively inelastic with respect to changes in the cost of teachers' services, (i.e., $(\partial T_E/\partial WT)\cdot(WT/T_E) > -1$. The demand for elementary teachers employed in unified districts is relatively inelastic with respect to each of the opportunity costs. This pattern does not follow, however, for elementary teachers employed in elementary districts where the absolute values of the price elasticities are relatively larger than those for elementary teachers in unified districts and are greater than unity in two cases (i.e., with respect to WI and WA).

The demand for high school teachers appears to be generally more price-elastic than the demand for elementary teachers. Perhaps one might attribute this difference in price-elasticities to the probable difference in the nature of the perceived educational technologies for the two levels of education. That is, variations in high school class sizes may not have as significant an impact on the perceived quality of educational services as would a similar variation in elementary school class sizes.[37] Therefore, one would expect that a change in the price of teachers' services would tend to elicit a relatively greater response in the demand for high school teachers than in the demand for elementary school teachers.

Notice that while the demand for teachers is negatively related to the cost of teachers' and the cost of administrative services (reflected by WT and WA, respectively), the demand for teachers is positively related to the opportunity cost facing teachers' aides. The implication of this result is that the cross-compensated-substitution effect between teachers and teachers' aides is positive and outweights the budget effect.[38] That is, teachers' aides are substitutes for teachers in the production of educational services. Although teachers' aides cannot legally or effectively replace a teacher in the classroom, their presence reduces the burdens imposed on the teacher by larger classes. Hence, to some extent, one might expect that one response by school decision-makers to a rise in the relative cost of teachers' services would be to increase class sizes (reduce the demand for teachers) and at the same time increase the demand for teachers' aides to compensate for the lower teacher-pupil ratios, and vice versa.

It can also be seen in examining the empirical results that class size is positively related to district size although the relation is statistically insignificant.[39] For example, the differential in class size attributed to an increase in district size from minus one to plus one standard deviation from the mean is about 1 2/3 more pupils for high school classes and about 2/5 more pupils in elementary classes, ceteris paribus. This positive effect of district size on class size may reflect some combination of a stronger preference for larger classes in larger school districts and/or the impact of increased district size on the costs of instructional and administrative inputs (i.e., the salaries of teachers and administrators) which in turn reduces the demand for teachers (increases class size).

The Demand for Teacher Quality. The empirical estimates of the demand equations for teachers' experience and education are contained in Table 2. In examining

Table 2 about here

the results of these teacher quality demand equations, one discovers that Frey's (1973) conclusion "that once in equilibrium the school board will continue to be on its equilibrium 'expansion path' simply by increasing or decreasing the number of teachers" is inconsistent with the evidence.[40] The key results which reveal the inconsistency is the statistical significance of the budget in determining the demand for teachers' experience and education by elementary districts and the demand for teacher education in unified districts. For elementary districts the budget variable, (1/R), is statistically significant at the 99 percent level in both quality demand equations. For unified districts the 2SLS estimates of the budget elasticities of the demand for elementary and high school teacher education are both significant at the 95 percent level.[41] That is, ceteris paribus, an increase in the size of the district budget leads the school board along an "expansion path" which requires both an increase in the number of teachers (see Table 1) and the quality of those teachers as indicated by the increase in the demand for teacher experience and education.

These results are in direct contrast to Frey's theoretical conclusions. It does, in fact, appear that wealthier school districts do "outbid" poorer districts for the services of better quality teachers. The extent to which this is true is an empirical question and one which will be discussed further in connection with the estimates of the salary equations.

In Section I it is suggested that school districts operate under a constraint on the choice of teacher quality due to the existence of tenure laws for teachers. That is, tenure laws allow districts to choose the number of teachers on the basis of enrollment needs, but in some cases constrain the district's choice of the combination of teacher quality characteristics (i.e., which teachers will be employed). Tenure arrangements require districts to retain teachers according to their seniority. Hence, district decision-makers may find themselves having to retain a teaching staff with more experience or educational preparation than would otherwise be desired. Constraining teacher quality to be greater than the desired (or optimal) level implies that the marginal benefits relative to the marginal costs of additional units of teacher quality characteristics are lower than for alternative school inputs.

If enough districts in the samples are operating under the teaching quality constraint, the demand for the quality characteristic(s) would be constrained away from the optimal level (that which would be chosen in the absence of the constraint) and would, therefore, be unrelated to the independent variables (Z, R). Based on this criterion, the demand for teacher experience by unified districts appears on the average, to be close to the lower bound constraints.[42] For the demand equation for high school teacher experiences one cannot reject the null hypothesis that the coefficients are identically zero (see Table 2), while for the equation for elementary teacher experience one can just barely reject the null hypothesis at the 95 percent level of significance. Furthermore, the budget variable is <u>not</u> statistically significant at even the 90 percent level in either the demand equation for elementary or high school teachers' experience by unified districts. These results are consistent with the hypothesis that the marginal benefits relative to the marginal costs of additional teacher ex-

perience is smaller than that for alternative school inputs. Because of the constraints imposed by teacher tenure arrangements on district decision-making, school officials are unable to adjust the level of teacher experience downward to its optimal level. Evidently, school decision-makers would prefer a higher rate of turnover among teachers which would allow for the replacement of the older, relatively more experienced teachers with the newer and more inexperienced teachers. That is, the higher rate of turnover increases the ability of the district to adjust downward the average level of experience of a teaching staff with "too much" experience.[43]/

It is interesting to note that Levin (1970) recently presented some evidence that the marginal product per dollar spent on teacher verbal ability was less than the marginal product per dollar spent on teacher experience. This relationship implies that school districts have relatively too much experience and too little teacher verbal ability. Levin's finding is consistent with the results presented in this paper that unified districts apparently have more than the optimal amount of teacher experience due to the lower bound constraint on the districts' choice of the average level of personnel experience imposed by tenure.

One might alternatively conclude from the results of these teacher experience equations for unified districts that Frey's specification of the model of the school district is correct and that wealthier districts do not outbid poorer districts for teacher experience. However, this conclusion does not appear to hold for elementary school districts nor does it hold for either type of district with regard to teacher education. The author would suggest that it is doubtful that the preference structure or the perceptions of educational quality held by elementary or unified district officials should be so significantly different

as to cause this disparity in results. Based on this reasoning, it appears likely that the hypothesis proposed above regarding the impact of the tenure constraint is a more plausible explanation of the empirical results.

Salaries of School Personnel. The empirical estimates of the parameters of the salary equations are contained in Table 3. The results indicate that the budget

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Table 3 about here

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together with the exogenous variables explain a fairly substantial proportion of the variation in the dependent variables. For all but one of the salary equations for each type of district one can reject the null hypothesis that the vectors of coefficients are equal to zero. However, the null hypothesis cannot be rejected at even the 90 percent level of significant in the case of the equations for the salary increments paid to teachers for units of education (i.e., α_{Te}). This suggests that perhaps these salary increments are exogenous to the decision-making process of the school district.

The critical test of enogeneity of the personnel salaries is the statistical significance of the estimates of the budget elasticities. For purposes of comparison and to illustrate the differences in precision of the 2SLS and OLS estimates, both the OLS and 2SLS estimates of the budget elasticities are presented in Table 4. In general the results appear to be consistent with the

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Table 4 about here

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hypothesis that the salaries of teachers and administrators are endogenous to the decision-making process of the school district. Furthermore, the net effects of

a change in the budget on equilibrium salaries is positive, i.e., $(\partial W/\partial D) \cdot (\partial D/\partial R) = dW^*/dR > 0$. This result suggests that perhaps district decision-makers do perceive some positive contribution to educational quality by decreases in teacher turnover (θ) and/or increases in the level of teacher quality characteristics (q_{TO}), other than experience and education. This conclusion appears to hold true as well for superintendents and principals. That is, there apparently is some likelihood that the salaries of school personnel, both instructional and administrative, do depend upon a set of conventionally accepted individual quality characteristics (the demand for which is assumed to be positively related to the district's budget) other than the characteristics of experience and education which are commonly recognized in district salary schedules.

Note that some of the coefficients between personnel salaries and the fraction of minority pupils in a district are negative. This result is not necessarily inconsistent with the hypothesis that school personnel require positive pay incentives to work in districts with large proportions of minority pupils. The structural relation may well be positive, i.e., $\partial W/\partial SB, \partial W/\partial SS > 0$. The observed negative relationship may simply reflect, for example, a relatively strong negative relationship between the demand for the quality characteristics q_{TO} and the proportion of minority pupils. Perhaps minority groups rely to a relatively greater extent upon the traditional parameters of teacher quality such as experience and educational preparation rather than those characteristics which might be reflected by q_{TO}.[44]

The empirical results of Table 3 indicate a strong positive and statistically significant effect of district size (S) on the salaries of school personnel. This positive relationship is apparently a reflection of one or a combination of two factors: (1) there is likely to be a positive relationship between district size and the nonpecuniary disadvantages of employment in a given district, and

(2) there is some reason to suggest that the marginal product of personnel quality (and particularly administrative quality) is positively related to district size (i.e., $\partial MQ_{q_a} / \partial S > 0$).

Table 5 presents the magnitudes of the salary differential paid to teachers,

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Table 5 about here

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principals, and superintendents between large and small districts, ceteris paribus. For this purpose, a small (large) district is defined as one which is one standard deviation below (above) the mean district size. Notice that, to some extent, the difference in the salary differentials between elementary and unified districts reflect the smaller variation in the sizes of elementary school districts. It should be noted that without more complete data on the quality characteristics of staff members, it is not possible to separate empirically the proportions of the salary differentials attributed to each of the factors referred to above.

According to the results in Table 5, the differential district sizes appear to have more of an impact on superintendent's than on principals' salaries, and more of an impact on principals' salaries than on teachers' salaries. Both of the factors referred to above are likely to operate in this direction. One might argue that the burden associated with the nonpecuniary disadvantages of working in larger school districts (e.g., the greater the bureaucracy, the more impersonal relations between various levels of staff, and the greater diversity of community attitudes resulting in increased probability of conflict) is greater, the higher the position of the staff member in the hierarchy of district decision-making. The implied hypothesis is that the nonpecuniary disadvantages of district size increase with the scope of decision-making. Furthermore, the

impact of the size differentials on the marginal product of staff quality is likely to be greater, the higher the position of the staff member in the hierarchy of decision-making since the decisions of higher level staff members generally affect a greater quantity of resources and larger number of pupils. For example, the decisions of the superintendent will affect the operations of the entire district, while the decisions of the principals directly affect only a portion of the pupils in the district (i.e., the pupils in the respective school), and the teachers' decisions generally affect only those pupils in a single classroom.

The size differential effects on principals' salaries actually operate through a secondary mechanism. It has been observed empirically that larger school districts maintain larger schools than do smaller districts.[45] / Larger schools in turn imply larger administrative units to be operated by school principals. Finally, this suggests a higher marginal product for principals' quality which leads to the selection of the selection of better quality principals and the payment of higher principals' salaries by district decision-makers. A similar analysis also applies to the relationship between teachers' salaries and class size due to the positive relationship which has been noted between school size and average class size combined with the positive relationship between district size and school size. That is, larger districts apparently maintain larger schools which in turn seems to lead to larger class sizes. Larger class sizes imply a greater marginal product of teachers' quality (according to the reasoning in Section I) which leads to a greater demand for teacher quality and, hence, higher teachers' salaries.

Demand for Educational Expenditure. Attention of the empirical analysis will now turn to an evaluation of the impact of changes in various demographic and financial characteristics of the community and changes in factors reflecting

the relative price of educational services on the determination of district educational budgets.

Estimates of the expenditure demand equations are contained in Table 6.

Table 6 about here

In general these equations explain a reasonably substantial proportion of the variance in school expenditures across districts. The implications of these empirical results are generally consistent with those predicted by the model.

As predicted by the model, the partial derivative of educational expenditures with respect to state and federal grants (R_g) lie, for the most part, between zero and unity for both unified and elementary school districts. The estimates imply that, on the average, for every one dollar increase in federal or state aid per pupil in school districts, approximately eighty-five cents is used to increase school expenditures while the other fifteen cents is used to reduce the local burden of school property taxes. The magnitudes of these aids effects are consistent with the results of previous empirical studies of the aid effects on educational spending.[47]/

The empirical results are also consistent with the specification of the model to allow for the possibility of a difference between the income and aid effects. The impact of an increase in federal or state aid per household is statistically significantly larger than the impact of an equivalent increase in disposable income per household. These results suggest that school decision-makers are more willing to spend for educational services out of aid funds from federal or state sources than they are from the income of residents of the local community.[48]/

The magnitude of the income effect for elementary districts ($\partial R/\partial Y = 0.063$) is in line with the estimates presented in previous studies which range from 0.023 to 0.060.[49] The estimated income effect for unified districts is statistically insignificant, and based on the results reported in previous studies appears to be quite low ($\partial R/\partial Y = 0.0083$). One might suggest that there has been a confounding of the income with the tax base composition effects which are represented by the set of variables 1/V, Y/V, SB/V, and SS/V. Employing alternative formulations of the expenditure equation for the unified districts including various combinations of the income and tax base composition variables, one discovers a range of estimates for the income effect of from 0.0037 to 0.025 with the t-statistics ranging from 0.15 to 1.58, respectively. (For the sake of comparison, the same alternative formulations were run against the elementary data. The results indicate little difference from the results reported in Table 6 except when the variable 1/V is left out of the equation. Leaving 1/V out of the equation has the effect of reducing the income coefficient from 0.063 to 0.046. For the unified data, elimination of 1/V raises the income coefficient from 0.0083 to 0.025.) Perhaps a larger sample with better data on the income and tax base composition variables will be required to assess more precisely the effects of changes in community income on local educational expenditures.

There are two aspects of the effects of a change in the pupil-household ratio on school expenditures. On the one hand, an increase in the pupil-household ratio reflects an increase in the number of school age children per family which increases the tax burden of educational expenditures per family and leads to a negative effect on school spending. On the other hand, an increase in the pupil-

household ratio may reflect an increase in the number of families in the community with school age children, increasing the preferences of the community (and, hence, school decision-makers) for educational services (Q*) and, thereby, exerting a positive influence on school spending. Empirical estimates indicate that the net effects of a change in the pupil-household ratio on school expenditures appears to be negative. Based on the estimates, a one percent increase in the pupil-household ratio would lead to approximately a 1/4th of one percent decrease in school spending for unified districts and 2/5th's of one percent decrease in school spending for elementary school districts. Apparently, the negative impact on school expenditures resulting from the increased tax burden per family (which is due to the increased number of school age children per family) required to support a given level of educational quality is stronger than the positive impact on school spending resulting from the relatively greater preference for improvements in educational quality that one would expect to characterize a community with a larger number of families with school age children.

As indicated in Section I, an increase in the ratio of residential to total assessed value of property (i.e., γ) will tend to reduce educational spending since residents of the community will tend to bear a larger proportion of the local tax burden. This reflects the hypothesis that school decision-makers give stronger weight to the preferences of residential as opposed to business property taxpayers within the community.[49] This effect is referred to as the tax base composition effect.

Combining the fact that $\partial R/\partial \gamma < 0$ with the information contained in equation 11, the signs of the following derivatives of the expenditure equation can be specified: $\partial R/\partial(Y/V) < 0$, $\partial R/\partial(SB/V) > 0$, and $\partial R/\partial(SS/V) > 0$. An increase in the

nonresidential (or business) tax base is reflected by an increase in V holding Y, SB, and SS constant. Therefore, an increase in V, which reduces the ratio of residential to total assessed property value ($\nu = V_r/V$), should have a positive impact on educational spending, i.e., $\partial R/\partial V > 0$.

In general the empirical estimates of these various partial derivatives are consistent with the theoretical specification of the tax base composition effects. As the ratio of real income to total real assessed property value increases, the ratio of the real value of residential to total property increases which reduces the incentives for school decision-makers to spend for educational services. Based on the parameter estimates in Table 6, a one percent increase in the ratio of real income per household to real assessed property value decreases educational spending, on the average, by 0.44 percent in unified districts and 0.60 percent in elementary districts.

An increase in SB and SS, ceteris paribus, would be expected to have a negative impact on the ratio of residential to total property value in the community. Hence, an increase in the ratios (SB/V) and (SS/V) should lead to an increase in school spending. All but one of the coefficients have the correct sign (i.e., positive). The coefficient SB/V for unified districts has a negative sign but is statistically insignificant. Because of the high pair-wise correlation between the variables (SB/V) and SB, the incorrect sign on (SB/V) could perhaps reflect a confounding of the effects of (SB/V) with SB.

Finally, as is demonstrated below, an increase in total property value (V) holding Y, SB, and SS constant (which amounts to an increase in business property) does have a positive effect on educational spending. For unified districts, one obtains

$$\frac{\partial R}{\partial V} = \frac{-1}{V^2}\,(1{,}357{,}780 - 400.0 \cdot Y - 7{,}285{,}420 \cdot SB + 4{,}729{,}700 \cdot SS)$$
$$= 0.0148 > 0$$

and for elementary districts,

$$\frac{\partial R}{\partial V} = \frac{-1}{V^2}\,(1{,}662{,}740 - 529.0 \cdot Y + 6{,}577{,}050 \cdot SB + 663{,}028 \cdot SS)$$
$$= 0.0028 > 0$$

where the values of the derivatives are calculated at the mean values of the variables V, Y, SB and SS. In terms of elasticities these results suggest that, on the average, a one percent increase in the real value of property leads to a 0.140 percent and 0.035 percent increase in educational expenditures in unified and elementary districts, respectively.

The exogenous variables included in the vector Z reflect, in part, the prices of the school inputs and to that extent provide school decision-makers with some concept of the cost of educational quality. The three major variables which reflect the prices of school inputs are the opportunity costs WT, WI, and WA facing teachers, instructional aides, and school administrators, respectively. The results in Table 6 indicate that school expenditures are positively related to the opportunity cost variables in all but one case (i.e., $\partial R/\partial WI < 0$ for elementary districts). However, given the colinearity which apparently exists between these variables, it is difficult to draw conclusions with regard to the individual elasticities. The overall effect of an increase in the (implicit) price of educational quality (i.e., the effect of a uniform increase in WT, WI, and WA) does appear to be positive which suggests that school decision-makers tend to resist significant decreases in the quality of educational services in response to increases in the costs of these services. This result is consistent with the hypothesis that the demand for educational quality by the community is relatively inelastic..

The Indirect Allocative Effects. The total impact of a change in one of the exogenous variables on the equilibrium personnel salaries and input demand depends upon the direct effects (if any) on the "allocation of educational resources," and the indirect effects on the determination of educational expenditures (i.e., the size of district budgets), based on the "allocation of community resources" problem.

Because of the relatively small budget elasticities which characterize the supply price and input demand equations, the total impact of changes in the various elements of Z are not substantially different from the direct allocative effects discussed above. For example, the effects of district size on salaries and input demand are not altered perceptibly; and the implications regarding the relative price elasticities of elementary as opposed to high school teachers are basically unchanged, although the magnitudes are somewhat smaller.

Perhaps the most interesting indirect allocative effects involve the differences between districts caused by differences in the levels of community income (Y) and the state and federal grants (R_g). The empirical results indicate that, ceteris paribus, districts with higher levels of income per household or larger grants per pupil will tend to spend more on educational services, pay higher salaries to school personnel, and employ greater quantities of school inputs per pupil. Because of the manner in which state, and to some extent federal, grants are distributed, there is an inverse relation between the level of community income and grants-in-aid across school districts: higher income communities generally receive lower levels of grants, and vice versa.[51] / One of the objectives of providing school districts with state and federal grants-in-aid is to equalize educational opportunities across districts by compensating

for the existing disparities in wealth which would otherwise lead to differences in the quality of educational services supplied to children from different socioeconomic backgrounds. It is, therefore, an interesting exercise to determine to what extent differences in the distribution of these state and federal grants compensate districts for differences in community income.

Using the parameter estimates reported in Table 6, one can estimate the difference in school spending observed between high and low income districts attributed to the combination of the income differential and the differential levels of grants-in-aid between the districts, ceteris paribus. Because of the apparent difficulty in isolating the effects of changes in community income on school spending in the sample of unified districts (see the discussion of the expenditure demand equation above), only the results for the sample of elementary districts will be used to calculate these differential effects of income and government grants on resource allocation.

Let ΔR and ΔY be the net budget differential and the income differential between the high and low income district, and let $\Delta R_g / \Delta Y$ represent the differential level of grants associated with a given income differential within the sample of school districts. Then equation (12) can be used to estimate the net budget differential between high and low income elementary districts.

$$\Delta R = (0.83 \cdot \frac{\Delta R_g}{\Delta Y} + 0.063) \cdot \Delta Y. \quad (12)$$

$\Delta R_g / \Delta Y$ is estimated for the sample of elementary districts using linear regression. The estimates indicate that for each additional $1,000 of community income per household, the average elementary district gives up $18.02 in grants-in-aid per pupil. Given this estimate of $\Delta R_g / \Delta Y$, if one finds that

$\Delta R > 0 (< 0)$ for a positive income differential, then it implies that, on the average, high (low) income districts spend more than low (high) income districts despite the differential level of grants. Alternatively stated, if $\Delta R > 0 (\leq 0)$, it suggests that the distribution of grants-in-aid does not (does) compensate districts for differences in community income.

Substituting the empirical estimates of $\Delta R_g/\Delta y$ into equations (12), one finds that for each additional $1,000 of income per household, there is a net addition to the school district budget (despite the lower level of grants-in-aid per pupil to higher income districts) equal to $48.04 per pupil in elementary districts, respectively. Table 7 illustrates a hypothetical example of the net

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Table 7 about here

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differences in school spending, salaries of school personnel, and the demand for school inputs between a high and low income district. The income differential between the two hypothetical districts is assume to be $4,000 per household which is equal to somewhat less than two standard deviations for the sample of elementary districts. Differences in resource allocation attributed to the income differential are reported in column (1) and, as would be expected, imply higher levels of school spending, higher personnel salaries, and greater demand for inputs in the high income districts. Column (2) reports the negative differential in school spending, personnel salaries, and input demand attributed to the lower level of grants per pupil (equal to $72.08 = 4 x $18.02) received by the higher income districts. The net differences in resource allocation are reported in column (3).

Even with the lower level of outside grants, the higher income districts

still spend more on educational services, pay higher salaries which, presumably, attract better quality school personnel, and maintain smaller classes. However, the net differentials do appear to be marginal which would suggest only relatively small differences in the quality of educational services, ceteris paribus. But it is not likely that everything else is equal. For example, if (as is likely the case) the children in the low income districts are relatively disadvantaged in terms of their endowments of human capital upon entry into school, then even with no differences in the quantities of school resources applied to the children between high and low income districts there could still be substantial differences in the level of educational outcomes and, hence, educational quality.[53]/

APPENDIX

TABLE A

SYMBOLS, DEFINITIONS, DATA SOURCES, MEANS, AND STANDARD DEVIATIONS OF ALL THE VARIABLES[a]

Symbols (Definitions)		Data Source	Unified Districts		Elementary Districts	
			Mean	Standard Deviation	Mean	Standard Deviation
C_e	(av. elem. class size)	[C]	28.67	1.49	28.22	2.12
C_h	(av. high sch. class size)	[C]	28.08	2.30	---	---
T_e	(elem. teacher-pupil ratio)	$1/C_e$	0.050	0.0019	0.0356	0.0029
T_h	(high sch. teacher-pupil ratio)	$1/C_h$	0.0359	0.0030	---	---
W_{OT}	(base wage for teachers)	[H]	7,146	287.	7,027.	379.
α'_{TX}	(salary increment for additional years exper.)	[H]	402.	69.	377.	60.
α'_{TE}	(salary increment for additional units of educ.)	[H]	36.	7.	37.	6.
W_{P_e}	(av. elem. principal's salary)	[D]	18,119.	1,355.	17,701.	1,108.
W_{P_h}	(av. high sch. prin. salary)	[D]	20,982.	1,753.	---	---
W_S	(salary of dist. supt.)	[E]	27,677.	3,973.	25,706.	3,002.
R	(educ. budget per pupil)	[A]	945.	218.	874.	152.
WP	(av. wage reg. nurses)	[J]	8,093.	225.	8,036.	314.4
WI	(av. wage nurses aides)	[J]	4,455.	306.	4,534.	359.
WA	(av. wage public agrs. excluding sch. admin.)	[J]	12,306.	457.	12,511.	370.
S	(av. daily attendance)	[A]	12,935.	10,435.	6,921.	4,633.
SE	(prop. elem. pupils)	[A]	0.698	0.040	---	---
SB	(prop. Black pupils)	[K]	0.030	0.056	0.011	.016
SM	(prop. Spanish pupils)	[K]	0.165	0.142	0.116	0.099
R_g	(state and fed. aid per pupil)	[A]	369.	97.	356.	101.
S/N	(pupils per household)[b]	[A], [I]	0.78	0.23	0.81	0.31
Y	(disposable income per household)[c]	[I]	7,777.	1,710.	9,469.	2,359.
V	(assessed prop. value per household)	[A]	8,963.	5,190.	10,594.	4,512.

[a]All of the monetary variables are deflated by regional price indices. The relative price levels for several large cities in the western United States are reported directly in source [M]. The price indices for the regions not specifically cited in [M] are extrapolated from information on population and region using a procedure described in M. J. Boskin, "The Economics of the Labor Supply," Memorandum No. 110, Research Center in Economic Growth, Stanford University, 1970.

[b]The variable S/N is constructed as the ratio of average daily attendance to the number of tax returns (N) filed by residents of the district where the number of tax returns serves as a proxy for the number of households.

[c]Disposable income per household is represented empirically by the difference between adjusted gross income and income tax per taxpayer in 1966 adjusted for the growth in disposable income between 1966 and 1970.

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FOOTNOTES

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[1]School district decision-makers are generally the members of the local board of education and the high level administrators (e.g., the superintendent) of the district. However, in some district voter approval is required for certain types of decision (e.g., overriding tax rate maximums set by the state). In these situations the members of the community must be regarded as part of the team of district decision-makers.

[2]School decision-makers actually appear to pay little systematic attention to outcomes and the relationships between outcomes and inputs of the educational process. Their efforts and debate are more commonly focussed on the inputs of the system as proxies for quality. Due to their efforts to minimize conflict in decision-making and maximize the credibility of their decisions, school officials have established implicit standards ('rules of thumb') regarding the relative perceptions of the value of various school inputs. For a detailed discussion of school decision-making and the impact of institutional arrangements which characterize public schools see the author's Ph.D. dissertation, 1975.

[3]For example, in the case of teachers, one might well include teacher verbal ability--a characteristic of teachers which has been found to be highly correlated with student performance on achievement tests--in the set of teacher quality characteristics. The reader is referred to Kiesling (1971) for a discussion of the effects of teacher characteristics on pupil achievement which have been found in recent studies in educational production.

The mechanism by which teacher verbal ability affects student achievement has never been precisely determined. It has been ventured that perhaps this characteristic reflects a teacher's general intelligence or ability to communicate, which are two traits one might expect to affect a teacher's ability to improve student achievement.

[4]Katzman (1971) discovered that teacher turnover had a negative effect on six measures of elementary school output including student performance on a set of standardized tests in reading and mathematics, two measures of academic achievement and aspirations of students, and two measures of the attractiveness of the school to pupils.

[5]This relationship may be due to actual or perceived affects of district size on quality. For example, administrative ability to organize resources may well be related to district size. This author has suggested elsewhere (1972) the hypothesis that due to the increasing difficulties of managing larger systems, educational administrators may tend to increase the size and reduce the number of individual units operating within the system. In this way, the costs of monitoring and controlling the operations of the individual units will be lower. One implication of this thypothesis is that larger school districts will tend to have not only larger schools, but also larger class sizes, ceteris paribus.

[6]Because of the lack of any definitive concept of an educational technology, it is not possible to be precise about the nature of the effects of these pupil characteristics. However, some estimates of the effectiveness of various teacher characteristics indicate that there may well be differences according to the racial and ethnic characteristics of pupils (see Levin (1970) and Hanushek (1970)).

Katzman (1971) cites evidence that the working class community tends to prefer the "traditional and conservative approach to education, ...stands for larger classes rather than increased buildings, . . . (and) opposes the employment of additional staff and advocates the reduction of special services." On the other hand, upper class communities tend to favor "aggressive building programs, small classes, and the adoption of the latest educational technologies." (pp. 8-14)

Because of data limitations, the variables SB and SS are intended to reflect possible differences in the perceived educational technology according to racial and ethnic background.

[7]All price and expenditure variables are presented in real terms.

[8]Higher salaries will presumably tend to reduce the incentives for staff members to search for alternatives to current employment. It is implicitly assumed in this analysis that turnover is primarily a result of voluntary movements on the part of staff members in the district. As is to be argued below, one of the effects of the tenure laws is to reduce the influence of district decision-makers regarding the hiring and firing of staff members.

For a further discussion of the relationship between wage rates and turnover or quit rates, the reader should consult Pencavel (1972) and (1973) and Mortensen (1970).

[9]Relatively large districts may be regarded as less attractive places to work due to the impersonal relationships between administrators and teachers, the distance placed between the average staff member and the decision-making process, and the bureaucracy which appears to characterize larger school districts. Since the convention is to assume that there are physic disadvantages associated with attempting to educate students from an ethnic or racial minority (whether it be due to the difficulty of teaching relatively disadvantaged students or simply due to discrimination on the part of educators), one would predict a positive relation between salaries and the fraction of minority students in a district. Both Levin (1968) and Toder (1971) found positive relationships between the fraction of minority pupils and public school teachers' salaries. Toder also reports that none of the other socioeconomic indicators had a corresponding effect on teachers' salaries.

[10]These employee categories (nurses, nurses aides, and public administrators) were selected based on the assumption that they involved similar levels of training and skill, and similar work force compositions in terms of race, ethnic and sexual characteristics.

[11]For discussion of the provisions of the various state tenure laws, see Tenure Laws--1972, National Education Association Research Report, p. 15.

[12]According to the California tenure law, a school district would have almost as much difficulty in releasing a legally nontenured teacher as it would a tenured (or "permanent") teacher. Hence, the phrase "effectively tenured" is intended to refer to both legally tenured as well as any "probationary teacher" who decides to remain employed in a given school district.

[13]For purpose of this exposition the turnover rate is assumed to be equal to the fraction of newly hired staff. Any differences which may arise (e.g., due to the rapid growth of a district) are ignored since the ultimate point of this analysis would not be changed, i.e., the relevance of these constraints to the decision-making process.

[14]Presumably, given a long enough period of time, ceteris paribus, the constraints implied by the tenure laws would not be binding since the district is assumed to exert control over θ and $q^{(h)}$. By altering θ, the district should ultimately be able to affect $q^{(t)}$ and q. Hence, the tenure constraints actually reflects the existence of a short run disequilibrium caused by some exogenous factors operating on teacher turnover decision and $q^{(t)}$. The recent surplus in the market for teachers and current economic conditions could have altered choice patterns which ultimately would affect trade-offs between wages and turnover. This shift in the trade-off may well result in a short run disequilibrium for local school districts.

[15]The minimum level of education required is effectively the B.A. degree (or zero units of post-graduate education). The minimum experience is obviously zero years of experience. Hence, q_{min} is defined to be zero. The maximum quality q_{max}, corresponds to the maximum number of units of quality which a given staff member may possibly posses (e.g., the greatest number of years of education--or units of college credit--or years of experience for which staff members earn salary increments). The minimum and maximum values of other characteristics (e.g., teacher verbal ability) correspond to the minimum and maximum feasible choices of the characteristics which appear in the markets for various categories of staff members (e.g., the minimum and maximum intellectual capabilities of those willing to supply such services).

[16]In deriving the properties of the demand and salary equations, (6) and (7), one finds that the signs of the partial derivatives of demand with respect to the various exogenous variables are generally ambiguous. This ambiguity results primarily from the fact that a change in any one of the exogenous variable potentially affects the marginal cost of more than one of the inputs. This implies that in order to evaluate the signs of the partial derivatives of demand with respect to these exogenous variables, one would have to identify the signs of a combination of compensated substitution effects as well as the sign of the income effect. A detailed analysis is carried out in Appendix A of the Author's doctoral dissertation, 1975.

[17]Even this approach is not flawless since teachers applying for employment possess some given combination of the quality characteristics (q_x, q_e, q_0) which obviously cannot be purchased separately. Because of this composite nature of the selection of quality characteristics and limitations on the supply of teachers, it is not clear that district choices will be as clear cut as implied in the text.

[18]For some discussion and evidence on this hypothesis see Mayer (1960) and Roberts (1956).

[19]The model postulated for the determination of the budget is a modified version of a model developed by Barro (1974) in his definitive work on school spending.

[20]Preferred positions move in the direction of lower tax burdens and/or higher educational quality, ceteris paribus.

[21]Competition across communities for the location of business property will tend to moderate this effect in the long run. The size of the net effect is an empirical question.

[22]See Lau (1969) for a discussion of the properties of indirect utility functions.

[23]Barro's (1974) model includes income (Y) in the tax burden function as a determinant of the preferences of school decision-makers. This formulation allows for the possibility of a difference between the effects of lump-sum grants from higher levels of government and changes in income of community residents rather than treating community income as a constraint as would be done in the direct analog to the consumer demand model. The reader is referred to Barro's discussion of the various rationales for this formulation in Chapter IV.

[24]In California most of the state aid is determined exogenously to the school district decision-msking process, since the local assessed valuation of property is exogenous. For a discussion of state aid to public schools in California, the reader should refer to Financing California Public Schools, the Budget, Finance and Salary Office of the California Teachers Association (1972). If the reader is interested in the effects of various matching aid formulas on school spending, refer to Barro (1974).

[25]Formally, the equilibrium conditions may be written as follows:

$$\frac{dT}{dQ} = MRS_{QT} = -\frac{\frac{\partial U}{\partial Q}}{\frac{\partial U}{\partial B} \cdot \frac{\partial B}{\partial T}} = \left(\frac{S}{N}\right)\frac{1}{\frac{\partial Q}{\partial R}} = \frac{S}{N} \cdot MC_Q$$

where MRS_{QT} = marginal rate of substitution between educational quality and school property taxes and $MC_Q \cdot \frac{S}{N}$ = the marginal cost per household of educational quality.

[26]This formulation is analogous to assuming separability of the individual consumer's utility function with respect to the two categories of goods: public education and all other goods and services. The properties discussed in the text are derived in a mathematical appendix which will be made available by the author on request.

[27]Katzman (1971) seems to imply that higher socioeconomic status communities express preferences for relatively more expensive types of educational technologies than do lower socioeconomic status communities. (See footnote 6).

[28]The teachers salary schedule is generally composed of a base salary for inexperienced teachers with the minimum educational requirements and salary increments paid for additional years of experience and units of graduate credit. Each of these components is a function of the endogenous and exogenous factors specified in the salary equation (see the budget constraint (2)). For example, these components of the salary schedule are likely to be dependent upon the teacher quality characteristics, such as teacher verbal ability, which are not explicitly recognized in district salary schedules.

[29]Moreover, data on the division of assessed property values between residential and business property are not easily accessible.

[30]Equation (11) is derived by dividing through equation (i) below by V,

$$V_r = \gamma_0 + \gamma_1 Y + \gamma_2 SB + \gamma_3 SS, \qquad \text{(i)}$$

where equation (i) describes the expression for the real residential property value (V_r).

[31]Preferably, one could have specified a quadratic relation in R to allow greater freedom for the data to choose the nature of the relationship. However, this alternative while producing a relation of a similar shape as (1/R) reduced the significance of the budget variable considerably due to co-linearity between R and R^2. Hence, 1/R was selected. The use of 1/S improved the predictive power of the estimates.

[32]One of the aspects of resource allocation in public school districts ignored by this model has been the effects of collective bargaining by teachers. However, the presence or absence of the bargaining variables does not substantially effect the remaining parameter estimates. An evaluation of the impact of bargaining is carried out in Chambers (1975).

[33]For example, the racial and ethnic characteristics of pupils (SB and SS) enter the model in a number of ways. These variables are included in the perceived quality function, the structural salary equations, the utility function of school decision-makers, and the function describing the variations in real residential property in a district. Given the complexity of these opposing forces combined with the small variation in these variables across the samples of districts, it is difficult, at best, to evaluate the impact of changes in SB and SS.

[34]See, for example, Ashenfelter (1971) and Ehrenberg (1973).

[35]This result was obviously imposed by the specification of the functional form of the expenditure variable. However, the estimates of these equations appeared to improve (in terms of the F-tests and t-tests on coefficients) with the use of the nonlinear form 1/R. Larger samples will be required to determine more precisely the appropriate functional relationship.

[36]Such school inputs may include instructional specialists who help design the various educational programs, school psychologists, specialized capital equipment (e.g., science laboratories for instruction, and larger gymnasiums). More data would be required to determine precisely which kinds of inputs are, in fact, more elastic with respect to change in the district budget.

[37]The affective outcomes of the educational process such as pupils' attitudes, values, abilities to cooperate and work with others, and the development of other social and interpersonal skills are perhaps better accomplished in relatively smaller classes. Moreover, children at early stages of development are more likely to require the class personal attention of the teacher and may be more responsive to changes in such attention than older children. Given the relatively greater importance which is likely to be attributed to these aspects of the educational environment within elementary school education one would predict a differential impact of changes in class size on perceived educational quality between elementary and high school. There also may be less rigidity in the technology of secondary education with regard to the substitution of other inputs (e.g., captial inputs-computer assisted instruction, laboratory facilities in science and language--and/or teachers' aides) for teachers. In effect, the goals of high school education may not be threathened by larger numbers of pupils per teacher to the extent that the goals of elementary education are.

[38]Supra note 16.

[39]Supra note 5.

[40]Frey chose a Cobb-Douglas form for his educational quality function for the school district. His rationale was that teacher quality and the teacher-pupil ratio should enter the function multiplicatively since teacher quality would obviously have no meaning in a district without any teachers. However, one could just as well have specified a quadratic functional form which satisfies Frey's criterion and yet does not rule out the possibility that district wealth would affect the district's choice of teacher quality.

The optimization model which Frey proposes for the school district decision-makers leads to the usual equilibrium conditions that the ratios of the marginal products of the inputs (teacher quality and number of teachers) be equal to the ratios of the respective marginal costs. Given the specification of the functions which Frey suggests, both of these ratios are proportional to the quantity of teachers employed in the district. This implies that the school district's movements along its "expansion path" are accomplished simply by changing the number of teachers employed. If, in fact, either of these ratios of marginal products or marginal costs is not proportional to the number of teachers, this result does not hold and district wealth will indeed have an effect upon the quality of the teaching staff selected.

[41]The OLS estimates of these budget elasticities were significant at the 99 percent level.

[42]Recall that the upper bound constraint on q_{Tx} and q_{Te} are not binding since most school districts are observed to hire most of their new teachers with the minimum or close to the minimum levels of experience and education required. To say that a district is operating on its lower bound constraint implies that virtually all new teachers possess the minimum amounts of experience and/or education.

[43]It is interesting to note that in casual conversations with many teachers, this author has discovered that most teachers perceive school decision-makers as constantly seeking ways to hold down the average level of experience of the teaching staff. On the other hand, school officials appear to encourage teachers to acquire additional units of graduate education since many districts require teachers to take some minimum number of units every so many years in order to progress beyond certain points on the salary schedule.

[44]Levin (1970) found that teacher experience appears to be twice as cost effective for Negro pupils than for whites.

[45]Supra note 5.

[46]For a summary of the results of the previous studies, the reader is referred to Barro (1974), Table 2 in Chapter II.

[47]In Chapter III of Barro (1974), this issue and some alternative rationales for the existence of differences in the income and aid effects are discussed. Since this issue is not the central focus of this research, these alternative explanations are not presented here.

[48]See Barro (1974), Table 2 in Chapter II, for a summary of the income effects estimated in previous studies.

[49]Recall that residents are voting taxpayers.

[50]That is, the value of residential housing services declines as the fraction of Negro or Spanish-American residents increases.

[51]State grants are largely based on assessed value of property in the district: the greater the assessed valuation of property, the smaller, in general, will be the state aid. To the extent that property in the district is residential, districts with relatively high assessed valuation of property are generally higher income districts. This result simply reflects the fact that higher income families exhibit a greater demand for housing services. Moreover, both the state and federal governments provide categorical aid of which a substantial portion is directed toward improving educational opportunities for relatively disadvantaged children. Based on these considerations, one would expect higher income communities to be receiving a lower level of state and federal grants-in-aid than lower income communities.

[52]The derivative of the budget equation with respect to grants-in-aid (i.e., $\partial R/\partial R_g$) is calculated at the mean value for (S/N).

[53]See Kiesling (1971) and Averch, et al (1972), Chapter III, for reviews of the impact of socioeconomic status of pupils on educational outcomes.

TABLE 1

TWO STAGE LEAST SQUARES ESTIMATES OF THE DEMAND FOR TEACHERS PER PUPIL BY UNIFIED AND ELEMENTARY DISTRICTS (t-STATISTICS IN PARENTHESES)

Dependent Variables / Independent Variables	UNIFIED DISTRICTS (50 observ.)		ELEMENTARY DISTRICTS (39 observ.)
	Elementary School Teachers T_E	High School Teachers T_H	Elementary School Teachers T_E
const.	0.066 (2.94)	0.13 (3.38)	0.14 (5.87)
1/R	-7.80 (-4.38)	-5.68 (-1.85)	-8.17 (-3.86)
WT	-0.0000032 (-1.46)	-0.000011 (-2.80)	-0.0000041 (-1.47)
WI	0.0000039 (1.45)	0.000017 (3.67)	0.000012 (3.37)
WA	-0.0000015 (-1.08)	-0.0000061 (-2.63)	-0.0000090 (-4.02)
SB	0.0056 (1.40)	0.0080 (1.17)	0.068 (3.27)
SS	-0.0034 (-1.96)	0.0000052 (0.00)	-0.0056 (-1.56)
1/S	1.23 (0.61)	5.64 (1.62)	1.63 (0.84)
SE	0.0070 (1.18)	-0.0046 (-0.46)	--
R-Squared	.52	.43	.70
F-Stat.[a]	5.48***	3.93***	10.21***

[a] *** = 99% significance level
** 95% significance level

TABLE 2

TWO STAGE LEAST SQUARES ESTIMATES OF THE DEMAND FOR TEACHERS' EXPERIENCE AND EDUCATION BY UNIFIED AND ELEMENTARY DISTRICTS (t-statistics in parentheses)

Dep. Variables	Unified Districts (50 observ.)				Elementary Districts (39 observ.)	
	Av. Exp. Elem. Tchrs.	Av. Exp. H. S. Tchrs.	Av. Educ. Elem. Tchrs.	Av. Educ. H. S. Tchrs.	Av. Exp. Elem. Tchrs.	Av. Educ. Elem. Tchrs.
Indep. Variables	$q_{T_E}x$	$q_{T_H}x$	$q_{T_E}e$	$q_{T_H}e$	$q_{T_E}x$	$q_{T_E}e$
const.	19.16 (1.74)	11.00 (0.84)	173.3 (2.68)	142.7 (1.81)	4.48 (0.45)	178.2 (2.30)
1/R	-958.2 (-1.09)	-1,035. (-0.99)	-12,423. (-2.41)	-13,303. (-2.11)	-3,257. (-3.59)	-16,206. (-2.32)
WT	0.000052 (0.48)	0.00019 (0.15)	-0.0085 (-1.33)	-0.0095 (-1.22)	0.0027 (2.23)	0.0019 (0.21)
WI	0.00075 (0.56)	0.00070 (0.44)	0.020 (2.51)	0.023 (2.41)	-0.0018 (-1.20)	0.015 (1.29)
WA	-0.00081 (-1.21)	-0.00033 (-0.41)	-0.0095 (-2.42)	-0.0081 (-1.69)	-0.00057 (-0.59)	-0.017 (-2.23)
SB	-2.02 (-1.03)	-0.64 (-0.28)	-17.63 (-1.54)	-13.80 (-0.99)	-14.60 (-1.64)	-5.25 (0.08)
SS	1.50 (1.76)	1.06 (1.06)	4.09 (0.82)	2.85 (0.47)	-1.85 (-1.19)	-18.94 (-1.59)
1/S	-370.5 (-0.37)	-1,360. (-1.15)	688.5 (0.12)	-2,706. (-0.38)	-1,036. (1.25)	-2,492. (-0.39)
SE	-8.51 (-2.92)	-4.23 (-1.23)	-41.03 (-2.41)	-18.67 (-0.90)	--	--
R^2	.31	.20	.49	.43	.43	.40
F-statistic[a]	2.30**	1.28	4.84***	3.90***	3.31***	2.94**

[a]*** = 99 percent significance level, ** = 95 percent significance level.

TABLE 3

TWO STAGE LEAST SQUARES ESTIMATES OF THE SALARY EQUATIONS
FOR UNIFIED AND ELEMENTARY DISTRICTS
(t-statistics in parentheses)

Dependent Variable	Unified Districts (50 observations)						Elementary Districts (39 observations)				
Independent Variable	Base Wage of Teachers W_{TO}	Salary Increment for Exp. α_{Tx}	Salary Increment for Educ. α_{Te}	Elem. Principal's Salary W_{PE}	H.S. Principal's Salary W_{PH}	Superintendent's Sal. W_S	Base Wage of Teachers W_{TO}	Salary Increment for Exp. α_{Tx}	Salary Increment for Educ. α_{Te}	Elem. Principal's Salary W_{PE}	Superintendent's Salary W_S
const.	-7,912. (-3.08)	234.1 (0.27)	6.68 (0.06)	-39,819. (-2.80)	-48,450. (-2.66)	-61,996. (-1.70)	-2,804. (-0.75)	447.4 (0.75)	-87.98 (-1.08)	-13,962. (-1.19)	7,575. (0.34)
1/n	-783,340. (-3.82)	-136,125. (-1.96)	-2,892. (-0.31)	-2,199,660. (-1.93)	-2,058,220. (-1.41)	-5,714,420. (-2.08)	-877,696. (-2.54)	-88,333. (-1.96)	7,731. (1.05)	-3,295,290. (-3.21)	-2,212,380. (-1.30)
WT	1.49 (5.87)	-0.0033 (-0.39)	0.0062 (0.55)	4.88 (3.47)	7.60 (4.22)	8.32 (2.36)	0.88 (1.92)	0.058 (0.81)	-0.0051 (-0.53)	4.17 (3.07)	-1.26 (-0.46)
WI	-2.06 (-6.63)	0.022 (0.21)	-0.0029 (-0.21)	-7.31 (-4.24)	-7.71 (-3.50)	-10.26 (-2.37)	-1.56 (-2.77)	0.13 (1.56)	-0.0067 (-0.56)	-3.67 (-2.20)	-0.75 (-0.24)
WA	0.90 (5.76)	0.024 (0.45)	-0.0002 (-0.04)	4.12 (4.77)	3.62 (3.38)	5.57 (2.59)	0.82 (2.44)	-0.081 (-1.38)	0.015 (1.54)	1.53 (1.40)	2.81 (1.27)
SB	-265.7 (-0.58)	-76.98 (-0.50)	-7.09 (-0.40)	-2,973. (-1.17)	3,160. (0.98)	3,772. (0.60)	1,762. (0.52)	453.4 (0.86)	-100.8 (-1.40)	1,452. (0.14)	40,521. (2.05)
SS	-502.9 (-2.54)	58.90 (0.89)	1.31 (0.15)	-2,886. (-2.63)	-4,681. (-3.33)	-10,125. (-3.48)	211.9 (0.36)	132.7 (1.41)	-11.08 (-0.88)	-1,572 (-0.89)	1,407. (0.40)
1/S	-634,407. (-2.72)	-186,756. (-2.36)	-14,199. (-1.39)	-5,463,280. (-4.22)	-6,252,960. (-3.78)	-16,770,900. (-6.89)	-1,148,630. (-3.63)	-80,956. (-2.36)	6,433. (0.96)	-2,948,840. (-3.13)	-8,427,860. (-6.62)
SE	3,133. (4.63)	-34.31 (-0.15)	0.0316 (0.01)	5,882. (1.57)	2,229. (0.46)	12,552. (1.43)	--	--	--	--	--
R^2	.72	.36	.08	.61	.62	.62	.54	.50	.23	.53	.60
F-statistic[b]	13.13***	2.93**	0.46	8.10***	8.40***	8.27***	5.23***	4.46***	1.32	4.92***	6.63***

[a] These regressions are weighted by $1/\sqrt{s}$ to adjust for heteroscedasticity.

[b] *** = 99 percent significance level
** = 95 percent significance level.

TABLE 4

ESTIMATES OF BUDGET ELASTICITIES OF SUPPLY PRICES IN UNIFIED AND ELEMENTARY DISTRICTS[a]

Supply Prices	Unified Districts		Elementary Districts	
	2SLS	OLS	2SLS	OLS
Teachers' Base Wages (W_{TO})	.12***	.08***	.14**	.11**
Teachers' Salary Increments exp. (α_{TX})	.36*	.52***	.27*	.36***
Elementary Principal's Salary (W_{P_E})	.13*	.16***	.21**	.19***
High School Principal's Salary (W_{P_H})	.10	.17***	--	--
Superintendent's Salary (W_S)	.22**	.26***	.10	.13*

*** = 99% significance level
** = 95% significance level
* = 90% significance level

[a]Budget elasticities are calculated at the mean values of each of the variables. Mean values of all variables are presented in the Appendix.

TABLE 5

SALARY DIFFERENTIALS FOR SCHOOL PERSONNEL BETWEEN LARGE AND SMALL UNIFIED AND ELEMENTARY SCHOOL DISTRICTS[a]

Supply Prices of School Personnel	Unified Districts	Elementary Districts
Teachers' Base Wages (W_{TO})	$227	$403
Teachers' Salary Increments exp. (α_{TX})	67	28
Elementary Principal's Salary (W_{P_E})	1,951	1,034
High School Principal's Salary (W_{P_H})	2,234	--
Superintendent's Salary (W_S)	5,991	2,989

(All of these estimates are statistically significant at the 99 percent level except for the figures for α_{TX} which are significant at the 95 percent level.)

[a]Large and small school districts are defined to be one standard deviation above and below the sample mean district size(s), respectively, for each type of district, unified and elementary, individually. Let s^L and s^S be the sizes of a large and small district, respectively. The salary differential due to district size may then be calculated as

$$W(\cdots, s^L, \cdots) - W(\cdots, s^S, \cdots) = \beta_S \left(\frac{1}{s^L} - \frac{1}{s^S}\right) = \frac{\Delta W}{\Delta S}$$

where β_S is the coefficient of $1/S$ in the regressions. For unified districts $s^L = 23,370$ and $s^S = 2,500$ while for elementary districts $s^L = 11,554$ and $s^S = 2,283$.

TABLE 6

EXPENDITURE DEMAND EQUATIONS FOR UNIFIED AND ELEMENTARY DISTRICTS
(t-statistics in parentheses)

Dep. Variables / Indep. Variables	Unified Districts (50 observ.) Per Pupil Budget R^a	Elementary Districts (39 observ.) Per Pupil Budget R
const.	947.9 (0.60)	-1,292. (-0.99)
WT	0.18 (1.17)	0.23 (1.46)
WI	0.00028 (0.00)	-0.32 (-1.66)
WA	0.056 (0.54)	0.14 (1.18)
SB	1,651 (0.59)	930.7 (0.23)
SS	-696.5 (-2.27)	-270.8 (-0.44)
1/S	147,685 (0.57)	250,931 (2.42)
SE	-2,076 (-3.09)	--
R_g (S/N)	1.10 (2.48)	1.02 (3.68)
(S/N)	-706.4 (-2.89)	-780.1 (-5.12)
Y	0.0083 (0.33)	0.063 (2.60)
1/V	1,357,780 (-0.85)	1,662,740 (0.77)
(Y/V)	-400.0 (-2.00)	-529.0 (-2.38)
(SB/V)	-7,285,420 (-0.44)	6,577,050 (0.25)
(SS/V)	4,729,700 (2.03)	663,028 (0.14)
R^2	.68	.79
F-statistic[b]	5.30***	7.34**

[a]The regression equation for unified districts is weighted by multiplying through by $\sqrt{s}$ to adjust for heteroscedasticity.

[b]*** = 99% significance level, ** = 95% significance level.

TABLE 7

THE DIFFERENTIALS IN EDUCATIONAL EXPENDITURES PER PUPIL, SALARIES OF SCHOOL PERSONNEL, AND INPUT DEMAND BETWEEN TWO COMMUNITIES WITH AN INCOME DIFFERENTIAL OF $4,000 PER HOUSEHOLD[a]

Dependent Variables[b]	Units	Elementary Districts		
		Differentials Due To		
		Difference in Community Income (1)	Difference in Grants-in-Aid Per Pupil (2)	Net Difference (1) + (2) = (3)
R	($)	252	-60	192
W_{TO}	($)	230	-45	185
α_{Tx}	($)	23	- 5	18
W_{P_E}	($)	865	-168	697
W_S	($)	581	-113	468
C_E	pupils/class	-1.58	0.30	-1.28
$q_{T_E x}$	yrs. exp.	0.85	-0.17	0.68
$q_{T_E e}$	credit hours	4.25	-0.83	3.42

[a]Because of the nonlinear way in which the district budget enters the supply price and demand equations, it is necessary to select an initial level of the budget to evaluate the differentials in resource allocation. The initial level of the per pupil budget chosen to evaluate these differentials is the median budget for those districts (included in the sample) in which community income is within $500 on either side of one standard deviation below the mean for the sample of districts. The initial budget level is $862 per pupil for elementary school districts.

[b]The equation for the salary increment paid to teachers for units of education (i.e., α_{Te}) is excluded from this table because one could not reject the null hypothesis for the vectors of coefficients and the budget variable is not statistically significant.

[c]The regression estimates of P_E on Y indicate that for each additional $1,000 of income per household, the average elementary district gives up $18.02 in grants per pupil. The $4,000 income differential hypothesized above leads to a reduction in grants per pupil of $72.08 (= 4 × 18.02) for elementary districts.